

# The water influence on the temperature of the amphibole stability in the melts.

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The previous research showed that the behavior of the liquidus curves of the anhydrous silicates are well described by the ideal model of the water dissolving in the melt [1]. In this paper we present the theoretical analysis of the water melt concentration effects on hydrous mineral phase crystallization (amphibole as an example) from the same point of view.

**Features of the behavior of the amphibole stability curves.** In contrast to anhydrous phases the curve of the Amph stability has a temperature maximum under  $H_2O$ -undersaturated conditions at constant pressure. On the P-T graphics the melting curves of the amphibole also have the temperature and pressure maximums whereas the melting curves of the anhydrous silicates have the temperature minimum.

Previously the isobaric temperature maximum was explained as a result of (1) the change of the reaction type from hydration to melting or (2) the change of the role of  $H_2O$  in the melting reaction from a product to a reactant in point of the maximum with increasing of the water activity [2,3,5].

**General equation and its analysis.** The melt was consider as a ideal solution. The theoretical dependence of the amphibole-melt equilibrium temperature on a water concentration was obtained using the common type of the reaction of the amphibole crystallization and conventional expression of the equilibrium constant. Received equation predict existence of the maximum and allow to evaluate its position. The water concentration in the maximum point is independent on water speciation in the melt. Isobaric temperature maximum of the amphibole stability is explained by dual influence of the water on Amph-melt equilibrium. On the one hand according to crystallization reaction the water increases the amphibole stability. On the other hand due to water dissolution in the melt the mole fractions of the liquid silicate components decrease and as the result the amphibole stability decreases as well. Our conclusions are agree with recent results obtained by M.Ghiorso [4].

**Quantitative application to the system pargasite - $H_2O$ - $CO_2$ .** For quantitative assessment of this approach the experimental results in the system pargasite - $H_2O$ - $CO_2$  were used [5]. The coefficients of equation were calculated using the stability curves of the pargasite at 5 and 8 kbar for which the water contents in the melt are given in [5]. The results of our calculations at pressures from 2 to 10 kbar are presented on figures 1 and 2. The water solubility in the melt is estimated identically to [5]. Calculated and experimental curves are in good agreement.

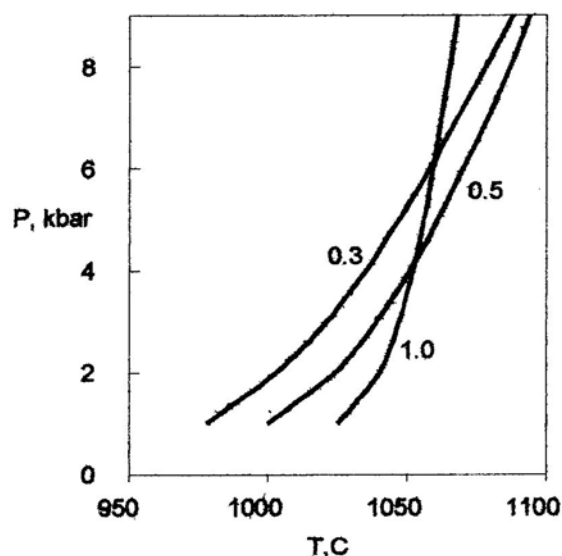


Fig. 1. Calculated P-T melting curves of pargasite for varies mole fraction of  $H_2O$  in the fluid ( $X_{H_2O}^{fl}$ ) (0.3, 0.5 and 1.0).

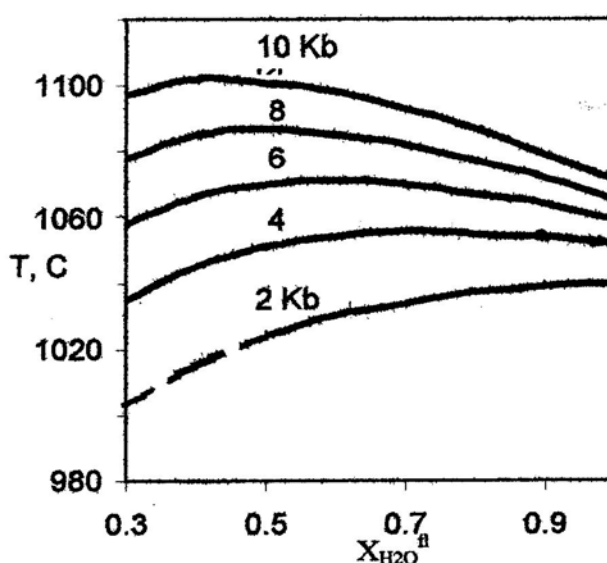


Fig.2. Calculated isobaric melting curves of pargasite as a function of  $X_{H_2O}^{fl}$ .

**Experimental data processing.** The main goal of this work is the development of the equations to describe the behavior of the natural amphiboles in the melts. On the first step the described method was applied to derive the equations of the tremolite and pargasite crystallization using INFOREX data base [6]. The ambiguity estimation of the mole fractions and activity of the amphibole end-members is the main difficulty at calculations of the amphibole equilibrium. The number of the same assumptions are accepted as at derivation of the equations as well as at their applications. The water content in the melt is calculated using a modified model of Burnham [7]. Several different equations of the amphibole-melt equilibrium were analyzed. Average differences of the calculated and experimental temperatures are about 35°. The calculations based on the hydroxyl and molecular water speciations in the melt are practically identical. The change of the supposed number of the silicate particles in the melt did not improve the results. Note that the temperatures calculated on tremolite and pargasite equilibria are very close as a rule.

**Conclusions.** The results of conducted analyses show that the amphibole behavior in the melt could be described in terms of ideal model of the water dissolution. In the first approximation the effect of the activity coefficients of the melt components is negligible. Probably insufficient precision of the results for natural systems is caused by the error at the calculations of the amphibole structural formulas. Apparently, the model needs of the significant corrections. First of all it is important to pay attention to the existence of the temperature and pressure maximums of the amphibole stability on P-T projections. It is suggested these maximums are caused by the change of reaction volume effect with the pressure increase.

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